on a line and provisionally label them $P(0)$, $P(1)$, (∞), and if $P(x)$, $P(y)$ are provisional labels of any other two points, then there are projective constructions defining $P(x+y)$ and $P(xy)$, such that the laws for adding and multiplying labels obey the ordinary laws of algebra, *e.g.* $P(x+y)=P(y+x)$, including the limiting cases when x or y, or both, have one of the special values 0, 1, ∞. Hence it follows that from the base points $P\ (0,\ 1,\ \infty)$ we can construct a *rational scale* of points $P(r)$, where r is any rational, positive or negative number. It may be added that these are the only points on the line which can be reached from the base-points by projective constructions, and it would be a good exercise for the student to prove what is not absolutely demonstrated in the book, that this deduction is free from ambiguity; for instance, suppose $P(x)$, $P(y)$, $P(x+y)$ have each been deduced from the base-points by a chain of projective construction, it is required to prove that *the same point*, $P(x+y)$, is derivable from $P(x)$ and $P(y)$ by the single operation of addition.

The net result of these considerations may be put (among other ways) in the following form. Suppose we have a tetrahedral frame of lines with a point given on each line distinct from the two vertices of the tetrahedron which it contains. Then on each of the six lines we can construct a rational scale, and hence, by projective constructions alone, arrive at all points which can be defined by four rational homogeneous coordinates. This rational projective space is not continuous: to fill up the lacuna, it will be necessary to assume the existence of one linear continuum of points, and apparently this will be also sufficient.

Staudt, on the other hand, gives his constructions as the definitions of the addition and multiplication of throws; and because the laws of algebra are satisfied, he deduces the possibility of assigning numerical values to throws. On the whole, Staudt's procedure seems the more scientific, but it is not a matter of much importance.

A propos of involutions, attention may be directed to the proposition on p. 223: "Any projectivity in a one-dimensional form may be obtained as the product of two involutions." This is very interesting, because it shows that although involution is, in the first instance, a derivative idea (as a special case of projective correspondence) it may ultimately be regarded as elementary.

To indicate how far this volume proceeds, it will be sufficient to say that chapter x. deals with pairs and pencils of conics in a plane, and gives the typical algebraic forms according to the elementary divisors of the discriminant; while the next, and final, chapter is on families of lines, and treats briefly of ruled quadrics, line coordinates, and linear congruences and complexes. It might, by the way, interest applied mathematicians to point out that if we suppose a unit force acting along a given line, the six homogeneous coordinates of the line may be taken to be proportional to the moments of the force about the edges of the tetrahedron of reference.

G. B. M.

THE NEW PSYCHOLOGY.

Manual of Mental and Physical Tests: a Book of Directions compiled with special Reference to the Experimental Study of School Children in the Laboratory or Class-room. By Prof. G. M. Whipple. Pp. xix+534. (Baltimore, U.S.A.: Warwick and York, inc., 1910.)

IS psychology to rank among the exact sciences? This is the question which is at once raised when we look into Prof. Whipple's volume. We are reminded of Kant's famous pronouncement that psychology never could be a science, because it was impossible either to apply mathematics to its problems or to perform experiments upon the minds of others. Kant's dictum is a classical instance of the danger of prophesying the impossible. In the book before us the mathematical treatment of mental measurements is discussed in the third chapter, and the rest of the volume is made up of more or less happily devised experiments upon the minds and bodies of other people.

Yet nobody knows better than the author himself how relatively slight actual accomplishment has been. The contrast between the position of the psychologist and that of the doctor, for example, is very great. An insurance company will decide quite serious financial questions on the report of a medical man whose tests give sufficiently good *average* results for their purpose. But the psychologist has not yet achieved a position of such confidence. He deals with far subtler problems, and it is no fault of his that we have not yet begun to consult him on the future of our children. He frankly confesses that he is not ready to render such positive service; and whilst on one hand we may fairly congratulate ourselves on the fact that a serious attempt is being made to arrive at a better understanding of mental phenomena, it would, on the other hand, in Dr. Whipple's words, be wrong to speak

> "as if a science of mental tests had already been achieved. . . . To make such an assertion is surely misleading, for . . . there is, at the present time, scarcely a single mental list that can be applied unequivocally as a pyschical measuring-rod."

There is no general agreement about procedure, and in many cases psychologists do not know exactly what it is they are measuring, such is the "astounding complexity, variety, and delicacy of form of our psychical nature."

It would, nevertheless, ill become professional students of the older sciences to speak in contemptuous terms of a younger brother who is so conscious of his own shortcomings. Psychology may have long to wait for its Newton, but in the meantime the effort to collect facts in a scientific way should surely meet with every possible encouragement. The "man in the street" has long recognised the existence of differences in the mental characteristics of his friends. He accepts them in much the same spirit as folk regarded the weather, until the meteorologist began that painstaking collection of data which is just beginning to bear scientific fruit. We have more words to describe these personal differences than we have for

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the discussion of weather variations, but popular analyses are proverbially unsound, and the psychologist has in recent years attacked this problem of individual differences with vigour, ingenuity, and insight.

It is as presenting a survey of work in this direction that Prof. Whipple's book is to be regarded. Hitherto nothing of the kind has been available, and the author has rendered a capital service to English workers in this field by compiling from widely extended sources such mental tests as have been used with more or less success in the study of children. The tests are arranged in the order of the simplicity of the psychical processes involved. Beginning with those which concern physical and motor capacity, they pass through those which measure the various forms of sensory acuity, to others which deal with attention, memory, suggestibility, and close with the Binet-Simon tests of intellectual development. Each test is accompanied by a critical survey of work already done in regard to it, and an exhaustive bibliography. As a mere index to the literature of this branch of psychology, the book is of the greatest value. J. A. Green.

CULTIVATION OF THE LAND.

To Work a Grass Holding at a Living Profit, and the Cheap Cottage Problem. By H. B. M. Buchanan. Pp. vi+102. (London: Constable and Co., Ltd., 1910.) Price 1*s*. net.

FEW movements of recent years have attracted greater interest than the migration from town to country that now plays so large a part in the life of the village community. Not only does the well-to-do man live further out into the country, but the humbler town-dweller is being enticed out; and the agricultural labourer, instead of drifting off unheeded to the town, finds all sorts of inducements held out to him to remain where he is. Small holdings are one of the most important developments of this movement, and they are encouraged with the twofold object of getting more produce out of the land and of bringing up the next generation in the country rather than in the unhealthier conditions of the town. It is arguable that the small holding is, *per se*, uneconomical, since the small holder cannot have the intelligence of the good farmer, or he would long ago have become a large holder; but there can be no difference of opinion as to the desirability of raising the next generation in the country. This social aspect of the question has to be kept in view in dealing with the rather bulky literature that has grown up on the subject.

Mr. Buchanan has taken an honourable part in fostering the new movement. He has studied small holdings from within, having made some on his own estate and carefully watched their development. Two classes of small holders he considers are likely to succeed: experienced people who supplement the profits of the holding by outside employment; and colonies working on cooperative lines directed by skilled supervision. The basis of their work must be the cultivation of the land; they are not likely to succeed in raising poultry, geese, cows, &c., on purchased food, however profitable the expert may find the business. And the weak link in all our cultivation is, in Mr. Buchanan's view, the management of our grass land. To this problem, therefore, he devotes a considerable amount of attention.

Grass presents a more difficult set of problems than any other crop. It is left down permanently; seeds of all kinds blow on to the ground, and may, if they can, germinate and grow, and finally oust some of the grass previously there. There is, in fact, a constant competition for existence among the various plants, and, in general, the poorer the soil, the larger the number of plants present. Artificial manuring, mowing, grazing, and grazing supplemented by concentrated foodstuffs, all modify the conditions obtaining, and favour some species that develop to the exclusion of others. The farmer's problem is to adopt those methods of treatment that shall in the shortest time and at the least cost enable the species he wants to crowd out those he does not want. In a certain empirical way, methods are known that will more or less do this, and Mr. Buchanan sets them out clearly and concisely.

The cheap cottage problem is intimately bound up with the small holding movement. The very large landowner may be prepared to put up cottages and let them at a rent that brings in little or no interest on the outlay, but Mr. Buchanan does not think these "charity cottages," as he calls them, will solve the problem. He gives plans and specifications of cottages at 500*l*. the pair that are suitable and comfortable, but as the rent has to be 4*s*. 6*d*. a week to make the outlay profitable, he arranges that a garden and pigsty can be included, the profits of which shall pay the rent. Suitable hints are given to the cultivator, and also to the owner of the estate.

The book will be found very interesting and suggestive not only to those concerned in small holdings, but also to the cultivator and to those engaged in agricultural education work E. J. R.

NEW BOOKS ON CHEMISTRY.

(1) *Introduction to Practical Organic Chemistry, including Qualitative and Quantitative Analysis and Preparations.* By Dr. A. M. Kellas. Pp. viii+204. (London: H. Frowde and Hodder and Stoughton, 1910.) Price 3*s*. 6*d*. net.

(2) *New Reduction Methods in Volumetric Analysis.* A Monograph. By Prof. E. Knecht and Eva Hibbert. Pp. x+108. (London: Longmans, Green, and Co., 1910.) Price 3*s*. net.

(3) *Introduction to General Chemistry.* By Prof. J. T. Stoddard. Pp. xviii+432. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 7*s*. net.

(1) THE "Introduction to Practical Organic Chemistry" is divided into six sections. The first section deals with qualitative tests, the second with general laboratory operations; the third with preparations, the fourth and fifth with the analysis of specific compounds, and the sixth with ultimate organic analysis and molecular weight determinations.

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